The Computer Science of DNA Nanotechnology

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Abstract. DNA nanotechnology, pioneered by Seeman, Winfree, and Rothemund, exploits the information processing capabilities of nucleic acids to *program matter* to do our bidding at atomic and molecular scales. This field is now a rapidly growing interdisciplinary research adventure involving chemists, molecular biologists, computer scientists, materials scientists, electrical and computer engineers, and others. DNA tile assembly, DNA origami, and DNA strand displacement have enabled the programmed self-assembly of complex nanoscale structures, dynamic nanoscale machines, and nanoscale Boolean circuits. Applications on the horizon include patterning of smaller, faster computer chips; nanoscale detectors and instruments for measurement; and in-cell computers that diagnose and treat disease. This talk will survey the role of computer science in making DNA nanotechnology more productive, predictable, and safe. Topics will include the specification and verification of nanoscale systems, the intrinsic universality (a strong version of Turing universality) of self-assembly, the role of randomness in molecular programming, and the essential role of software in the *design* of wet-lab experiments in DNA nanotechnology.

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